Mono axis translation 1. Ciliary

DOCUMENT-IDENTIFIER: US 20020116061 A1

TITLE: Materials for use in intraocular lens system

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Pre-Grant Publication (PGPub) Document Number - PGNR (1):
20020116061

Pre-Grant Publication Document Identifier - DID (1):
US 20020116061 A1

Summary of Invention Paragraph - BSTX (7):
[0006] One aspect of the invention is an accommodating intraocular lens for implantation in an eye having an optical axis. The lens comprises an anterior portion which in turn comprises an anterior viewing element comprised of an optic having refractive power and an anterior biasing element comprising first and second anterior **translation** members extending from the anterior viewing element. The lens further comprises a posterior portion which in turn comprises a posterior viewing element in spaced relationship to the anterior viewing element and a posterior biasing element comprising first and second posterior **translation** members extending from the posterior viewing element. The anterior portion and posterior portion meet at first and second apices of the intraocular lens such that a plane perpendicular to the optical axis and passing through the apices is closer to one of said viewing elements than to the other of said viewing elements. The anterior portion and the posterior portion are responsive to force thereon to cause the separation between the

viewing elements to change.

Summary of Invention Paragraph - BSTX (8):
[0007] Another aspect of the invention is an accommodating intraocular lens for implantation in an eye having an optical axis. The lens comprises an anterior portion, which in turn comprises an anterior viewing element comprised of an optic having refractive power, and an anterior biasing element comprising first and second anterior **translation** members extending from the anterior viewing element. The lens further comprises a posterior portion which in turn comprises a posterior viewing element in spaced relationship to the anterior viewing element, and a posterior biasing element comprising first and second posterior **translation** members extending from the posterior viewing element. The anterior portion and posterior portion meet at first and second apices of the intraocular lens. The anterior portion and the posterior portion are responsive to force thereon to cause the separation between the viewing elements to change. The first anterior **translation** member forms a first anterior biasing angle, as the lens is viewed from the side, with respect to a plane perpendicular to the optical axis and passing through the apices. The first posterior **translation** member forms a first posterior biasing angle, as the lens is viewed from the side, with respect to the plane. The first anterior biasing angle and the first posterior biasing angle are unequal.

Summary of Invention Paragraph - BSTX (10):
[0009] A further aspect of the invention is an accommodating intraocular lens comprising an anterior portion which in turn comprises an anterior viewing element which has a periphery and is comprised of an optic

having refractive
power. The anterior portion further comprises an anterior biasing element
comprising first and second anterior **translation** members extending from the
anterior viewing element. The lens further comprises a posterior portion which
in turn comprises a posterior viewing element having a periphery, the posterior
viewing element being in spaced relationship to the anterior viewing element,
and a posterior biasing element comprising first and second posterior
translation members extending from the posterior viewing element. The first
anterior **translation** member and the first posterior **translation** member meet at
a first apex of the intraocular lens, and the second anterior **translation**
member and the second posterior **translation** member meet at a second apex of the
intraocular lens, such that force on the anterior portion and the posterior
portion causes the separation between the viewing elements to change. Each of
the **translation** members is attached to one of the viewing elements at at least
one attachment location. All of the attachment locations are further away from
the apices than the peripheries of the viewing elements are from the apices.

Summary of Invention Paragraph - BSTX (23):

[0022] A further aspect of the invention is an accommodating intraocular
lens. The lens comprises an anterior portion which in turn comprises an
anterior viewing element having a periphery and comprised of an optic having
refractive power, and an anterior biasing element comprising at least one
anterior **translation** member attached to a first attachment area on the
periphery of the anterior viewing element. The first attachment area has a
thickness in a direction substantially perpendicular to the periphery and a

width in a direction substantially parallel to the periphery. The ratio of the width to the thickness is equal to or greater than 3.

Detail Description Paragraph - DETX (9):

[0085] As best seen in FIG. 4, the lens system 100 has an anterior portion 102 which is anterior or forward of the line A-A (which represents a plane substantially orthogonal to the optical axis and intersecting first and second apices 112, 116) and a posterior portion 104 which is posterior or rearward of the line A-A. The anterior portion 102 comprises an anterior viewing element 106 and an anterior biasing element 108. The anterior biasing element 108 in turn comprises a first anterior **translation** member 110 which extends from the anterior viewing element 106 to the first apex 112 and a second anterior **translation** member 114 which extends from the anterior viewing element 106 to the second apex 116. In the illustrated embodiment the first anterior **translation** member 110 comprises a right arm 110a and a left arm 110b (see FIG. 3). In addition, the depicted second anterior **translation** member 114 comprises a right arm 114a and a left arm 114b. However, in other embodiments either or both of the first and second anterior **translation** members 110, 114 may comprise a single arm or member, or more than two arms or members.

Detail Description Paragraph - DETX (10):

[0086] As best seen in FIGS. 4, 5 and 7, the posterior portion 104 includes a posterior viewing element 118 and a posterior biasing element 120. The posterior biasing element 120 includes a first posterior **translation** member 122 extending from the posterior viewing element 118 to the first apex 112 and a second posterior **translation** member 124 extending from the posterior viewing

element 118 to the second apex 116. In the illustrated embodiment, the first
posterior **translation** member comprises a right arm 122a and a left arm 122b.
Likewise, the depicted second posterior **translation** member 124 comprises a
right arm 124a and a left arm 124b. However, in other embodiments either or
both of the first and second posterior **translation** members 122, 124 may
comprise a single arm or member, or more than two arms or members.

Detail Description Paragraph - DETX (11):

[0087] In the embodiment shown in FIG. 4, the anterior biasing element 108
and the posterior biasing element are configured symmetrically with respect to
the plane A-A as the lens system 100 is viewed from the side. As used herein
to describe the biasing elements 108, 120, "symmetric" or "symmetrically" means
that, as the lens system 100 is viewed from the side, the first anterior
translation member 110 and the first posterior **translation** member 122 extend
from the first apex 112 at substantially equal first anterior and posterior
biasing angles .theta..sub.1, .theta..sub.2 with respect to the line A-A
(which, again, represents the edge of a plane which is substantially orthogonal
to the optical axis and intersects the first and second apices 112, 116) and/or
that the second anterior **translation** member 114 and the second posterior
translation member 124 extend from the second apex 116 at substantially equal
second anterior and posterior biasing angles .theta..sub.3, .theta..sub.4 with
respect to the line A-A. Alternative or asymmetric configurations of the
biasing elements are possible, as will be discussed in further detail below.
It should be further noted that a symmetric configuration of the biasing
elements 108, 120 does not dictate symmetric positioning of

the viewing
elements with respect to the line A-A; in the embodiment shown in FIG. 4 the
anterior viewing element 106 is closer to the line A-A than is the posterior
viewing element.

Detail Description Paragraph - DETX (12):

[0088] Preferably, both the anterior viewing element 106 and the posterior
viewing element 118 comprise an optic or lens having refractive power. (As
used herein, the term "refractive" or "refractive power" shall include
"diffractive" or "diffractive power".) The preferred power ranges for the
optics are discussed in detail below. In alternative embodiments one or both
of the anterior and posterior viewing elements 106, 118 may comprise an optic
with a surrounding or partially surrounding perimeter frame member or members,
with some or all of the biasing elements/**translation** members attached to the
frame member(s). As a further alternative, one of the viewing elements 106,
118 may comprise a perimeter frame with an open/empty central portion or void
located on the optical axis (see FIG. 20 and discussion below), or a perimeter
frame member or members with a zero-power lens or transparent member therein.
In still further variations, one of the viewing elements 106, 118 may comprise
only a zero-power lens or transparent member.

Detail Description Paragraph - DETX (19):

[0094] As may be best seen in FIG. 6, the first anterior **translation** member
110 connects to the anterior viewing element 106 via connection of the left and
right arms 110a, 110b to first and second transition members 138, 140 at
attachment locations 142, 144. The second anterior **translation** member 114
connects to the anterior viewing element 106 via connection

of left and right
arms 114a, 114b to the first and second transition members 138, 140 at
attachment locations 146, 148. This is a presently preferred arrangement for
the first and second anterior **translation** members 110, 114; alternatively, the
first and second anterior **translation** members 110, 114 could be connected
directly to the anterior viewing element 106, as is the case with the
connection of the first and second posterior **translation** members 122, 124 to
the posterior viewing element 118.

Detail Description Paragraph - DETX (20):

[0095] However the connection is established between the first and second
anterior **translation** members 110, 114 and the anterior viewing element 106, it
is preferred that the attachment locations 142, 144 corresponding to the first
anterior **translation** member 110 be farther away from the first apex 112 than is
the closest edge or the periphery of the anterior viewing element 106. This
configuration increases the effective length of the first anterior **translation**
member 110/arms 110a, 110b, in comparison to a direct or straight attachment
between the apex 112 and the nearest/top edge of the anterior viewing element
106. For the same reasons, it is preferred that the attachment locations 146,
148 associated with the second anterior **translation** member 114 be farther away
from the second apex 116 than is the closest/bottom edge of the anterior
viewing element 106.

Detail Description Paragraph - DETX (21):

[0096] As best seen in FIG. 7, the first posterior **translation** member 122 is
preferably connected directly to the posterior viewing element 118 via
attachment of the left and right arms 122a, 122b to the

element 118 at
attachment points 150, 152. Likewise, the second posterior **translation** member
124 is preferably directly connected to the posterior viewing element 118 via
connection of the left and right arms 124a, 124b to the element 118 at
attachment points 154, 156, respectively. In alternative embodiments, the
first and second posterior **translation** members 124, 122 can be connected to the
posterior viewing element via intervening members as is done with the anterior
viewing element 106. No matter how these connections are made, it is preferred
that the attachment locations 150, 152 be spaced further away from the first
apex 112 than is the nearest edge or the periphery of the posterior viewing
element 118. Similarly, it is preferred that the attachment locations 154, 156
be spaced further away from the second apex 116 than is the closest edge of the
posterior viewing element 118.

Detail Description Paragraph - DETX (22):

[0097] By increasing the effective length of some or all of the **translation**
members 110, 114, 122, 124 (and that of the arms 110a, 110b, 114a, 114b, 122a,
122b, 124a, 124b where such structure is employed), the preferred configuration
of the attachment locations 142, 144, 146, 148, 150, 152, 154, 156 relative to
the first and second apices 112, 116 enables the anterior and/or posterior
viewing elements 106, 118 to move with respect to one another a greater
distance along the optical axis, for a given angular displacement of the
anterior and/or posterior **translation** members. This arrangement thus
facilitates a more responsive spring system for the lens system 100 and
minimizes material fatigue effects associated with prolonged exposure to
repeated flexing.

Detail Description Paragraph - DETX (23):
[0098] In the illustrated embodiment, the attachment location 142 of the first anterior **translation** member 110 is spaced from the corresponding attachment location 146 of the second anterior **translation** member 114 along the periphery of the anterior viewing element, and the same relationship exists between the other pairs of attachment locations 144, 148; 150, 154; and 152, 156. This arrangement advantageously broadens the support base for the anterior and posterior viewing elements 106, 118 and prevents them from twisting about an axis parallel to the lateral axis, as the viewing elements move between the accommodated and unaccommodated positions.

Detail Description Paragraph - DETX (24):
[0099] It is also preferred that the attachment locations 142, 144 of the first anterior **translation** member 110 be located equidistant from the first apex 112, and that the right and left arms 110a, 110b of the member 110 be equal in length. Furthermore, the arrangement of the attachment locations 146, 148, arms 114a, 114b and second apex preferably mirrors that recited above regarding the first anterior **translation** member 110, while the apices 112, 116 are preferably equidistant from the optical axis and are situated 180 degrees apart. This configuration maintains the anterior viewing element 106 orthogonal to the optical axis as the viewing element 106 moves back and forth and the anterior viewing element flexes.

Detail Description Paragraph - DETX (25):
[0100] For the same reasons, a like combination of equidistance and equal length is preferred for the first and second posterior

translation members 122,
124 and their constituent arms 122a, 122b, 124a, 124b and attachment points
150, 152, 154, 156, with respect to the apices 112, 116. However, as shown the
arms 122a, 122b, 124a, 124b need not be equal in length to their counterparts
110a, 110b, 114a, 114b in the first and second anterior **translation** members
110, 114.

Detail Description Paragraph - DETX (26):

[0101] Where any member or element connects to the periphery of the anterior
or posterior viewing elements 106, 118, the member defines a connection
geometry or attachment area with a connection width W and a connection
thickness T (see FIG. 4 and the example illustrated therein, of the connection
of the second posterior **translation** member 124 to the posterior viewing element
118). For purposes of clarity, the connection width is defined as being
measured along a direction substantially parallel to the periphery of the
viewing element in question, and the connection thickness is defined as
measured along a direction substantially perpendicular to the periphery of the
viewing element. (The periphery itself is deemed to be oriented generally
perpendicular to the optical axis as shown in FIG. 4.) Preferably, no
attachment area employed in the lens system 100 has a ratio of width to
thickness less than 3. It has been found that such a geometry reduces
distortion of the viewing element/optic due to localized forces. For the same
reasons, it is also preferred that each of the **translation** members 110, 114,
122, 124 be connected to the periphery of the respective viewing elements at
least two attachment areas, each having the preferred geometry discussed above.

Detail Description Paragraph - DETX (27):
[0102] FIGS. 17.1 and 17.2 show two preferred cross-sectional configurations which may be used along some or all of the length of the **translation** members and/or arms 110a, 110b, 114a, 114b , 122a, 122b, 124a, 124b. The shape is defined by a relatively broad and flat or slightly curved outer surface 182. It is intended that when in use the outer surface faces away from the interior of the lens system and/or toward the capsular bag 58. The remaining surfaces, proportions and dimensions making up the cross-sectional shape can vary widely but may advantageously be selected to facilitate manufacture of the lens system 100 via molding or casting techniques while minimizing stresses in the arms during use of the lens system.

Detail Description Paragraph - DETX (28):
[0103] FIG. 17.3 depicts a number of alternative cross-sectional configurations which are suitable for the **translation** members and/or arms 110a, 110b, 114a, 114b, 122a, 122b, 124a, 124b. As shown, a wide variety of cross-sectional shapes may be used, but preferably any shape includes the relatively broad and flat or slightly curved outer surface 182.

Detail Description Paragraph - DETX (29):
[0104] It is further contemplated that the dimensions, shapes, and/or proportions of the cross-sectional configuration of the **translation** members and/or arms 110a, 110b, 114a, 114b , 122a, 122b, 124a, 124b may vary along the length of the members/arms. This may be done in order to, for example, add strength to high-stress regions of the arms, fine-tune their spring characteristics, add rigidity or flexibility, etc.

Detail Description Paragraph - DETX (38):
[0112] FIGS. 18 and 19 depict another embodiment 250 of the intraocular lens. It is contemplated that, except as noted below, this embodiment 250 is largely similar to the embodiment disclosed in FIGS. 3-17. The lens 250 features an anterior biasing element 108 and posterior biasing element 120 which are arranged asymmetrically as the lens system 100 is viewed from the side. As used herein to describe the biasing elements 108, 120, "asymmetric" or "asymmetrically" means that, as the lens system 100 is viewed from the side, the first anterior **translation** member 110 and the first posterior **translation** member 122 extend from the first apex 112 at unequal first anterior and posterior biasing angles .delta..sub.1, .delta..sub.2with respect to the line B-B (which represents the edge of a plane which is substantially orthogonal to the optical axis and intersects the first and second apices 112, 116) and/or that the second anterior **translation** member 114 and the second posterior **translation** member 124 extend from the second apex 116 at substantially equal second anterior and posterior biasing angles .delta..sub.3, .delta..sub.4 with respect to the line B-B.

Detail Description Paragraph - DETX (39):
[0113] In the embodiment shown in FIGS. 18-19, the first and second anterior biasing angles .delta..sub.1, .delta..sub.3 are greater than the corresponding first and second posterior biasing angles .delta..sub.2, .delta..sub.4. This arrangement advantageously maintains the posterior viewing element 118 and apices 112, 116 in a substantially stationary position. Consequently, the moving mass of the lens system 250 is reduced, and the

anterior viewing element
106 can move more quickly over a wider range along the optical axis under a
given motive force. (Note that even where the posterior biasing element 120
and its constituent first and second posterior **translation** members 122, 124 are
substantially immobile, they are nonetheless "biasing elements" and
"**translation** members" as those terms are used herein.) In another embodiment,
the anterior biasing element 108 and posterior biasing element 120 are arranged
asymmetrically in the opposite direction, i.e. such that the first and second
anterior biasing angles .delta..sub.1,.delta..sub.3 are smaller than the
corresponding first and second posterior biasing angles .delta..sub.2,
.delta..sub.4. This arrangement also provides for a wider range of relative
movement of the viewing elements, in comparison to a "symmetric" system.

Detail Description Paragraph - DETX (52):

[0125] FIG. 21.3 shows another alternative configuration of the distending
portion 132, in which the distending members 134, 136 are integrally formed
with the first and second posterior **translation** members 122, 124. The
distending members 134, 136 and **translation** members 122, 124 thus form common
transition members 139 which connect to the periphery of the posterior viewing
element 118.

Detail Description Paragraph - DETX (58):

[0131] The stop members 190 shown in FIG. 22.1 are located on the first and
second anterior **translation** members 110, 114 of the anterior biasing element
108 and extend posteriorly therefrom. When the anterior and posterior viewing
elements 106, 118 move together, one or more of the stop members 190 will

contact the posterior **translation** member(s) 122, 124, thereby preventing
further convergent motion of the viewing elements 106, 118. Of course, in
other embodiments the stop member(s) 190 can be in any suitable location on the
lens system 100.

Detail Description Paragraph - DETX (62):
[0134] The center mold 506 includes a first center mold cavity 518 which
cooperates with the first mold cavity 508 to define a mold space for forming
the anterior portion 102 of the lens system 100. The first center mold cavity
518 includes a central anterior mold face 520 which, upon placement of the
center mold 506 in the first mold cavity 508, cooperates with the first
anterior mold face 510 to define a mold space for the anterior viewing element
106. In so doing, the first anterior mold face 510 defines the anterior face
of the anterior viewing element 106 and the central anterior mold face 520
defines the posterior face of the anterior viewing element 106. In fluid
communication with the chamber formed by the first anterior mold face 510 and
the central anterior mold face 520 are lateral channels 522, 524 (best seen in
FIG. 31) which form spaces for molding the first and second transition members
138, 140, along with the arms 110a, 110b of the first anterior **translation**
member 110 as well as the arms 114a, 114b of the second anterior **translation**
member 114. The first center mold cavity 518 also includes retention member
cavities 526, 528 which define spaces for molding the first and second
retention members 128, 130 to the anterior viewing element 106.

Detail Description Paragraph - DETX (64):
[0136] The center mold 506 includes a second center mold

cavity 552 which
cooperates with the second mold cavity 530 to define a mold space for the
posterior portion 104 of the lens system 100. The second center mold cavity
552 includes a central posterior mold face 554 which, upon placement of the
center mold 506 in engagement with the second mold cavity 530, cooperates with
the second posterior mold face 532 and the transition 534 to define a chamber
for forming the posterior viewing element 118. In fluid communication with the
chamber formed by the central posterior mold face 554 and the second posterior
mold face 532 are lateral channels 556, 558, 560, 562 which provide a mold
space for forming the arms 122a, 122b of the first posterior **translation** member
122 and the arms 124a, 124b of the second posterior **translation** member 124.
The second center mold cavity 552 includes lateral projections 564, 566 which
coact with the notches 538, 540 formed in the second mold cavity 530. The
chambers formed therebetween are in fluid communication with the chamber
defined by the central posterior mold face 554 and the second posterior mold
face 532 to form the first and second distending members 134, 136 integrally
with the posterior viewing element 118.

Detail Description Paragraph - DETX (85):

[0155] FIGS. 37 and 38 show a further embodiment 800 of the lens system, in
which the anterior and posterior biasing elements 108, 120 comprise integral
"band" like members forming, respectively, the first and second anterior
translation members 110, 114 and the first and second posterior **translation**
members 122, 124. The biasing elements 108, 120 also form reduced-width
portions 802, 804 which meet at the apices of the lens system 800 and provide
regions of high flexibility to facilitate sufficient

accommodative movement.
The depicted distending portion 132 includes three pairs of distending members
134, 136 which have a curved configuration but nonetheless project generally
away from the optical axis.

Claims Text - CLTX (3):
2. The lens of claim 1, wherein said elongate members comprise first and
second **translation** members.

Claims Text - CLTX (6):
5. The lens of claim 2, wherein: said first and second **translation** members
together form an anterior biasing element; said lens further comprises a
posterior biasing element connected to said anterior biasing element; said
posterior biasing element has third and fourth **translation** members, said third
translation member connected to said first **translation** member at a first apex
of said lens, said fourth **translation** member connected to said second
translation member at a second apex of said lens; said lens further comprises
a posterior viewing element connected to said third and fourth biasing
elements, said first optic and said posterior viewing element being aligned
along an optical axis of said lens; and said anterior and posterior biasing
elements bias said first optic and said posterior viewing element apart along
said optical axis, said first optic and said posterior viewing element being
moveable relative to each other to produce a range of accommodation upon
implantation of said lens in the eye of a patient.